Top Quark

and

Tau Lepton

Juerg Beringer
Lawrence Berkeley National Laboratory

Top Quark

- **Listings**
  - Encoder: Kaoru Hagiwara (KEK)
  - Overseer: Jeremy Lys → Jean-Francois Arguin → TBD
  - Coordinator: JB

- **"The top quark" review**
  - Tony Liss (Illinois) and Arnulf Quadt (Goettingen)
  - **Major revision**, now with detailed coverage of LHC results
  - 12 pages in big book

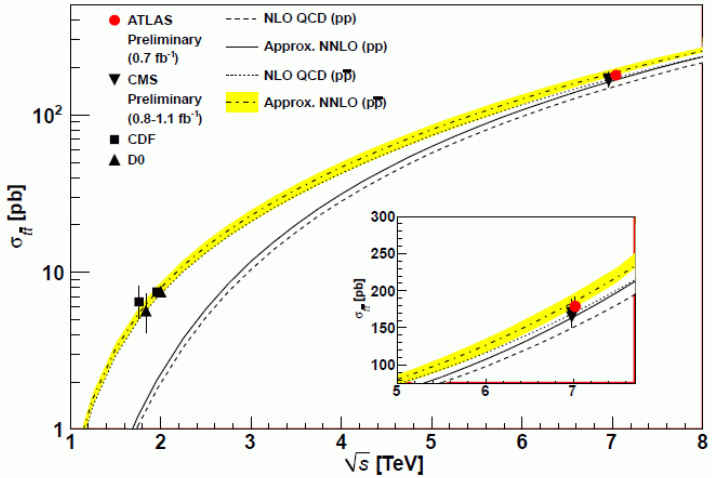


Figure 1: Measured and predicted $t\bar{t}$ production cross sections from Tevatron energies in $p\bar{p}$ collisions to LHC energies in pp collisions. Tevatron data points at $\sqrt{s} = 1.8$ TeV are from Refs. [25] and [26]. Those at $\sqrt{s} = 1.96$ TeV are from Refs. [17] and [18]. The ATLAS and CMS data points are from Refs. [20] and [22], respectively. Theory curves are generated using HATHOR [5] with input from Ref. [27] for the NLO curves and Ref. [2] for the approximate NNLO curves. Figure adapted from Ref. [19].

Highlights

- **New results in Listings**
  - 63 new measurements, **including 8 from LHC**
- **Top mass: 173.5 ± 0.6 ± 0.8 GeV (0.6% precision!)**
  - Weighted average from TEVEWWG and single CMS measurement
  - Future: **TOPLHCWG and TEVEWWG will produce combined average** (we are in close contact with both groups)
- **MC (pole) vs $\overline{\text{MS}}$ top mass from $\sigma_{t\bar{t}}$ measurements**
  - Discussed in top quark review
  - Separate data blocks in Listings
- **New quantities in Listings**
  - Spin correlation in $t\bar{t}$ production
  - Ratio of production cross section $t\bar{t}\gamma$ to $t\bar{t}$ at $\sqrt{s}$ = 1.96 TeV
  - Single t production cross section pp collisions at $\sqrt{s}$ = 7 TeV
  - $t\bar{t}$ production cross section in pp collisions at $\sqrt{s}$ = 7 TeV

Outlook for Top

- **Number of new top results has been steadily increasing**

	2002	2004	2006	2008	2010	2012
Papers	10	3	21	31	35	**51**
Measurements	16	4	29	38	47	**63**

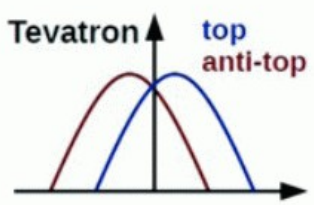
- **Expect many more top results from LHC in the next edition**
  - Many preliminary LHC top results not yet published by RPP 2012 deadline
  - Cross section measurements at 8 TeV, different top properties

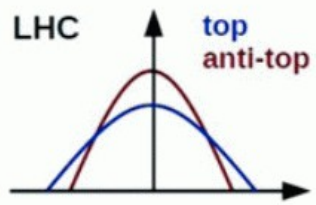
- **Hot topic: top A_{FB} and A_C**
  - Expect published results from LHC for next edition

$$A_C = \frac{N(|y_t| > |y_{\bar{t}}|) - N(|y_{\bar{t}}| > |y_t|)}{N(|y_t| > |y_{\bar{t}}|) + N(|y_{\bar{t}}| > |y_t|)}$$

A_{FB} of $t\bar{t}$ in $p\bar{p}$ collisions at $\sqrt{s} = 1.96$ TeV

VALUE (%)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
-11.6 ± 15.3	[1] AALTONEN	11F	CDF	$m_{t\bar{t}} < 450$ GeV
47.5 ± 11.4	[1] AALTONEN	11F	CDF	$m_{t\bar{t}} > 450$ GeV
19.6 ± 6.5	[2] ABAZOV	11AH	D0	$\ell + \not{E}_T + \geq 4$ jets($\geq 1b$-tag)
17 ± 8	[3] AALTONEN	08AB	CDF	$p\bar{p}$ frame
24 ± 14	[3] AALTONEN	08AB	CDF	$t\bar{t}$ frame
$12 \pm 8 \pm 1$	[4] ABAZOV	08L	D0	$\ell + \not{E}_T + \geq 4$ jets

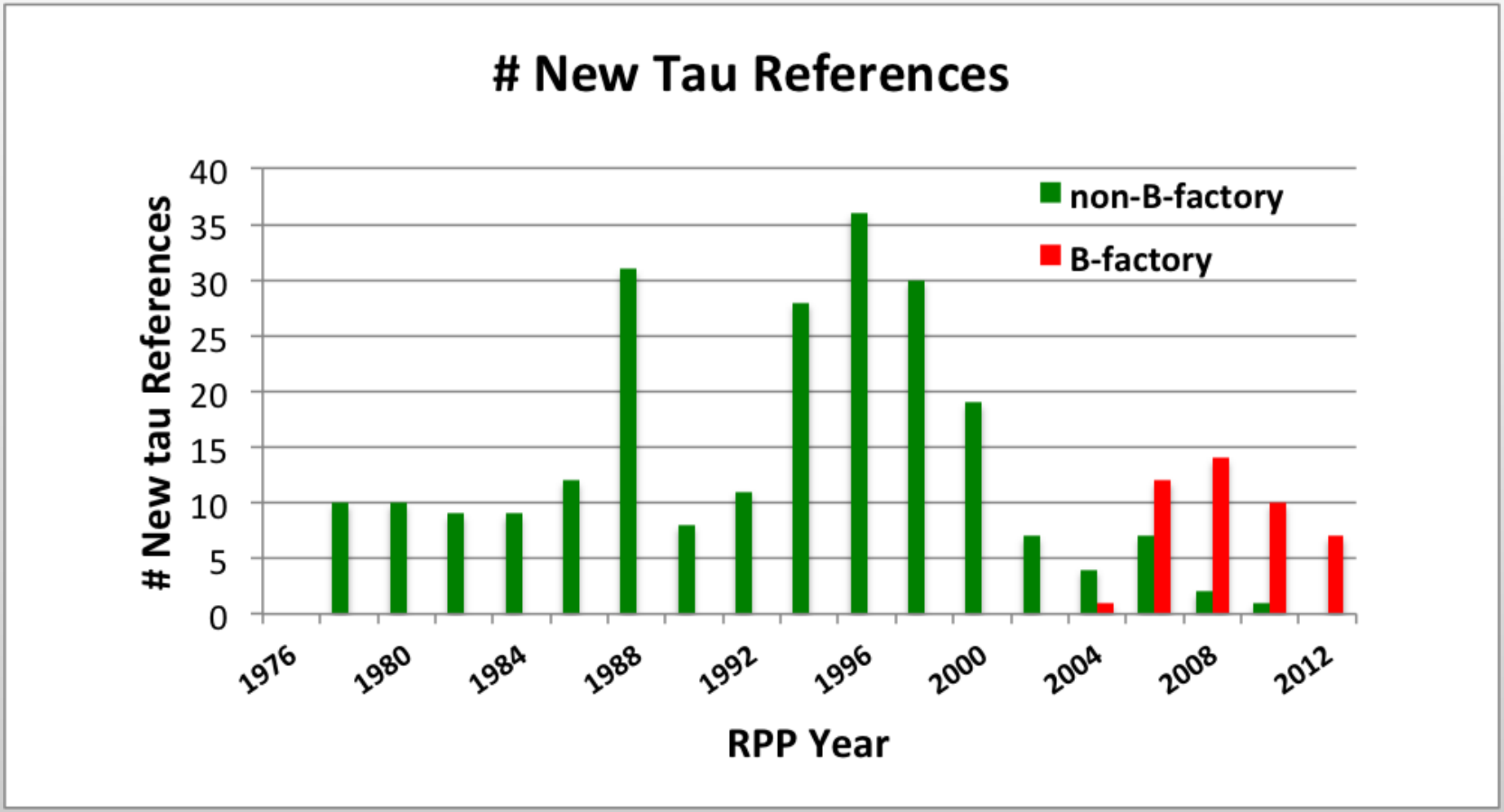




Tau

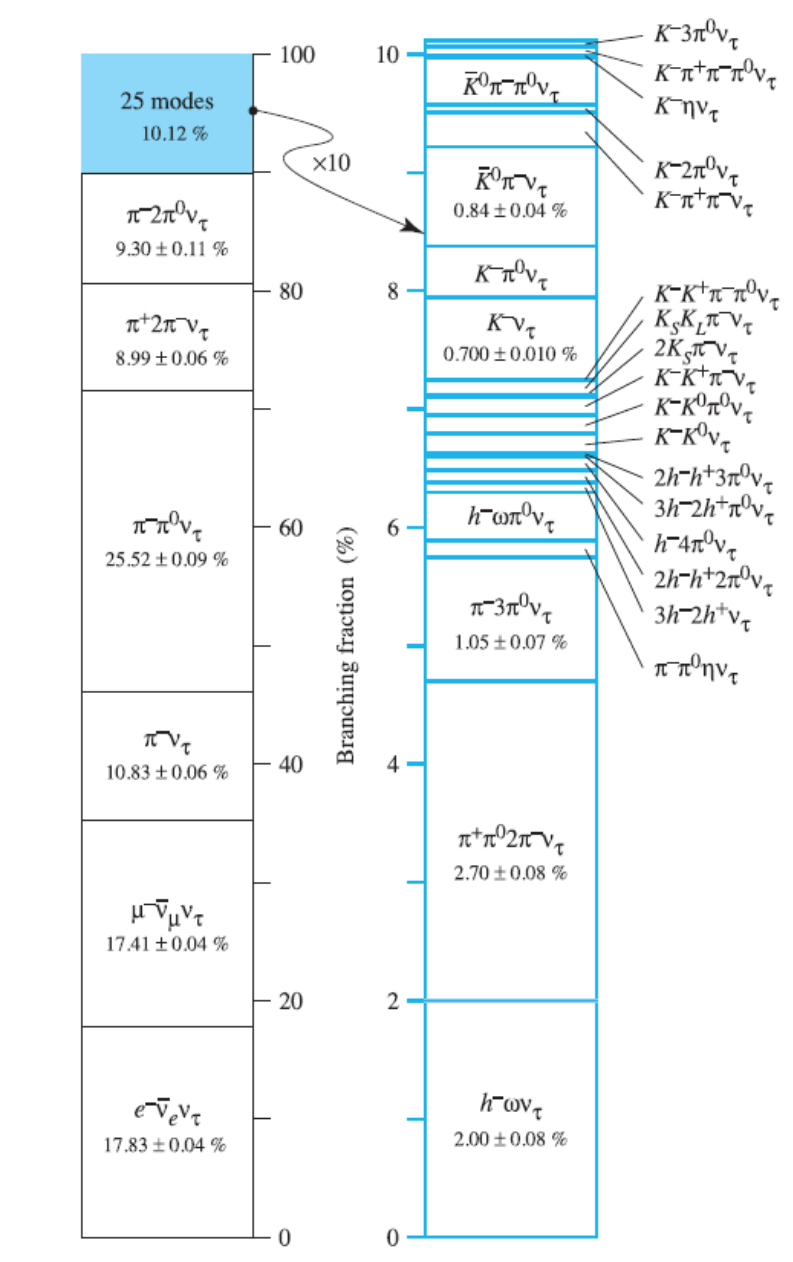
- **Listings**
  - Encoder: Ken Hayes (Hillsdale College)
  - Overseer: Klaus Moenig (DESY)
  - Coordinator: JB
  - 40 new measurements from 7 papers since RPP 2010
- **"τ branching fractions" review**
  - Ken Hayes (Hillsdale College)
  - Updated for latest fit
- **"τ-lepton decay parameters" review**
  - Achim Stahl (RWTH Aachen)
  - Minor updates

History of New Tau Results



Branching Fractions

- **Conventional τ decays**
  - 119 branching fractions
  - 31 limits
- **Constrained fit determines branching fractions for 82 modes**
  - 31 basis modes
  - χ^2 of 128.9 for 108 degrees of freedom
  - Use HFAG averages instead?
- **Total uncertainty of B-factory measurements on average 3.4x smaller than for corresponding non-B-factory ones**
  - ~60 times number of τ events
- **59 limits on lepton (family) or baryon number violating modes**



Inconsistencies

- **τ branching fractions from BaBar and Belle tend to be smaller than non-B-factory measurements**
  - Originally reported in RPP 2010
  - Similar study by HFAG, arXiv 1101.5138v1 (2011)
  - Average normalized difference decreased slightly from -1.36 in RPP 2010 to -1.30
- **Sizable differences for some decay modes between BaBar and Belle**
- **Overconsistency of leptonic branching fractions**
  - Probability of smaller χ^2 is 1.3% (0.08%) for B_e (B_μ)

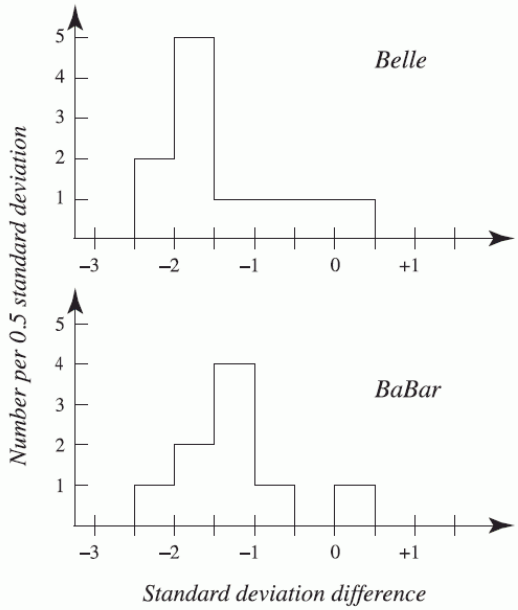


Figure 2: Distribution of the normalized difference between the 20 B-factory measurements of conventional τ-decay branching fractions and non-B-factory measurements. The Belle and BaBar collaborations have published 11 and 9 measurements respectively.

Mode	BaBar – Belle Normalized Difference ($\#\sigma$)
$\pi^-\pi^+\pi^-\nu_\tau$ (ex. K^0)	+1.4
$K^-\pi^+\pi^-\nu_\tau$ (ex. K^0)	−2.9
$K^-K^+\pi^-\nu_\tau$	−2.9
$K^-K^+K^-\nu_\tau$	−5.4
$\eta\, K^-\nu_\tau$	−1.0
$\phi\, K^-\nu_\tau$	−1.3